SURVEY OF OVER 13,000 FRACTURES*

IN THE EMPLOYEES OF THE RICHMOND SHIPYARDS

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THE 248,000 new cases seen by the Permanente Hospitals in Richmond and Oakland in the last two and one-half years included 13,261 fractures.

The value of a survey of this kind lies in presenting the general distribution of fractures occurring in the workmen of a heavy industry (shipbuilding) both on and off the job and of the general impressions regarding the treatment of fractures thus encountered. The medical care provided for the workmen in the Richmond shipyards included not only all industrial injuries occurring on the job but, in addition, those injuries and illnesses occuring off the job. Since approximately 90 per cent of the workmen belong to this additional voluntary health plan, the fracture experience presented in this report very closely represents the actual incidence of fractures occuring in the entire shipyard population (sixty to ninety thousand) during this two and one-half year period.

The figures as given represent individual fractures where they presented individual problems of treatment even though many patients sustained multiple injuries in a single accident. Except in the cases of metacarpal, metatarsal, phalangeal and rib fractures, they are enumerated individually.

Table 1.—*Regional Classification of 13,261 Fractures*

Name	Number of Fractures	Per Cent Incidence
Skull	193	1.5
Maxilla, Zygoma, Nasal	421	3.2
Mandible	117	0.9
Vertebrae—Cervical, Dorsal, Lumbar	320	2.4
Sacrum, Coccyx	70	0.5
Scapula	61	0.5
Clavicle	146	1.1
Sternum, Ribs	759	5.7
Pelvis	106	0.8
Humerus—head, neck	127	1.0
shaft	38	0.3
supra-condylar, condylar	69	0.5
Radius—head, neck	134	1.0
shaft (alone)	67	0.5
Radius and Ulna shafts (together)	80	0.6
Radius—distal end, including ulnar styloid	491	3.7
Ulna—styloid, head (alone)	58	0.4
Ulna—olecranon, coronoid	84	0.6
Ulna—shaft (alone)	56	0.4
Navicular and Carpals	237	1.8
Metacarpals and Phalanges	4,263	32.1
Femur—head, neck	24	0.2
trochanter	20	0.1
shaft	39	0.3
supra-condylar, condylar	34	0.3
Patella	138	1.0
Tibia—condylar, tuberosity	102	0.8
shaft (including Fibula)	324	2.4
Fibula—head, neck & shaft (alone)	200	1.5
Tibia—malleolus, epiphysis (alone)	180	1.4
Fibula—malleolus (alone)	198	1.5
Tibia—malleolus, epiphysis and Fibula—malleolus (together)	128	1.0
Tarsals	273	2.1
Metatarsals and Phalanges	3,704	27.9
Total Fractures	13,261	

* Read before the Section on Industrial Medicine and Surgery at the Seventy-fourth Annual Session of the California Medical Association, Los Angeles, May 6-7, 1945.

From the Permanente Foundation Hospitals.

SKULL

Although the 193 skull fractures were of primary interest to the Surgical Department they are included here for completeness of fracture statistics. The care for patients with skull fractures is primarily that of the associated head injury. Linear fractures of the skull require no special treatment for the bone injury. Fractures which are depressed for a distance equal to the width of the cortex are usually elevated. All compounded fractures are debrided and elevated if depressed.

FACE

Facial fractures involving the maxilla, zygoma and nasal bones numbered 421. These were of primary interest to the otorhinolaringolist. The elevation of a depressed zygomatic arch is usually very satisfactorily attained by direct elevation or by use of a periosteal elevator slipped through a temporal incision downward beneath the temporal fascia to the under side of the zygoma. It is essential that the presence of a depressed zygoma be recognized immediately following injury because its presence may later be obscured by swelling of the face and the satisfactory result following early elevation be sacrificed. Complications such as diplopia and ectropia emphasize the importance of adequate care of these fractures.

MANDIBLE

Fractures of the mandible (117) were treated jointly by the otorhinolaryngologist and the orthopedist. The use of external pin fixation methods have proved valuable in many instances of multiple fractures of the jaw and in edentulois cases. The majority of mandible fractures however, are satisfactorily treated with interdental wiring.

VERTEBRAE

Fractures of the vertebral column (320) have followed the usual distribution of these fractures. We feel that an initial rest period of three to seven days before reduction eliminates the complications of abdominal distension and general discomfort of the patient, as well as affording added opportunity of observing the patient for associated injuries. As a general rule, no attempt is made during this period to obtain a reduction of the fracture. Reduction is then carried out under spinal anesthesia in the cases of lower segment fractures. For the most part we have allowed the patient to become ambulatory in a body cast during the second week of convalescence although at the present time we feel that many fractures, particularly those involving any lateral wedging or fractures involving the articular facets require a much longer period of bed rest. Physiotherapy and muscle re-education are extremely important, during the later stages of healing. We have not been able to influence the wedging of the thoracic vertebral bodies above the tenth thoracic segment. Patients with fractures in this area are treated by cast and bed rest with muscle strengthening exercises for six to eight weeks and then are allowed to be ambulatory in the cast.

Sacral and coccygeal fractures numbered 70. We have not needed to resort to removal of the coccyx in any case. In general, the results of actual fractures of the sacrum and coccyx have given less difficulty and better results than the contusions to this area without fracture.

Clavicle fractures numbered 146. Satisfactory results have been obtained by use of the figure of eight bandage, the T cross or the Roger Anderson type clavicle splint. We have had one nonunion, this in the distal end of the clavicle with acromio-clavicular and coroco-clavicular ligament tears.

STERNUM AND RIBS

Fractures of the sternum and ribs numbered 759. Extensive fractures of the ribs involving the majority of ribs on one or both sides of the chest still present a very grave problem of management. The respiratory embarrassment which accompanies these injuries, complicated by paradoxical respiration, tension pneumothoraces and hemothoraces require constant supervision. Towel clip or wire traction to the ribs definitely gives some aid in decreasing mediastinal shifting. It is felt that the iron lung has definite value in some instances. As a general rule aspiration of a hemothorax is not carried out except for definite respiratory embarrassment. Decompression of a tension pneumothorax is of utmost importance. Areas of atelectasis and pneumonia following even trivial chest injuries are recognized, and strapping and limitation of motion of the ribs is discouraged. Whenever possible the pain associated with fractures of the ribs is controlled with intercostal nerve injections, hypodermic infiltration of novocaine or ethyl chloride spray.

PELVIS

Fractures of the pelvis (106) fall into two definite groups: those involving fractures of the weight bearing lines, that is, of the main arches, and those involving the secondary or tie arches alone. The majority of fractures of the latter group tend to override rather than distract and in the majority of cases treatment with a pelvic sling is not necessary. Fractures involving a separation of the symphysis pubis are of course treated with a pelvic sling.

The most serious fractures of the pelvis are those extending through or near the sacro-iliac joints. The double vertical fracture of the type described by Malgaigne requires traction over a prolonged period of time and displacement frequently recurs after eight weeks. The Watson Jones method of reduction and application of a spica cast has been used in several cases without satisfaction. The casts had to be removed because the reduction could not be maintained and because of the discomfort of the patient.

Lumbar plexus nerve injuries have been associated with several cases of sacral fractures and in general have had incomplete recovery.

HUMERUS

Fractures of the head, neck and shaft (165) have been, for the most part, very satisfactorily reduced and treated by use of hanging casts. An attempt is made to reduce the fracture in order to insure bony apposition. It is desirable to maintain slight abduction of the lower fragment to insure maintenance of the carrying angle. Early exercises of the shoulder joint are important and are usually begun in seven days.

Supracondylar fractures of the humerus are frequently comminuted and traction thereon is necessary. A downward pull on the proximal fragment, of the Dunlop variety, or Kirschner wire traction through the olecranon are of great value.

RADIUS

There were 134 fractures of the head and neck of the radius. Impacted fractures of the head may be treated conservatively with early mobilization. In non-impacted fractures of the head, open operation is indicated. Where less than two-thirds of the head remains intact, excision of the head has given satisfactory results. Shaft fractures of the radius alone were in most cases successfully treated by closed methods. If the fracture line is oblique it may require traction or open reduction to prevent shortening and consequent inferior radio-ulnar dislocation.

Fractures of the distal radius (491) were in general satisfactorily handled by closed manipulation. It has frequently been found advisable to extend the cast above the elbow. Comminuted fractures frequently require traction in order to prevent shortening. Operative methods are rarely used.

ULNA

There were 84 fractures of the olecranon and coronoid. Olecranon fractures with displacement are always opened. Coronoid fractures almost never require manipulation or open treatment. Fractures of the shaft of the ulna alone were usually no problem; nor were those of the ulnar head.

RADIUS AND ULNA

Fractures of both bones of the forearm with displacement may present a difficult problem. First attempt was always made at closed reduction. Even though first reduction seemed satisfactory, frequent x-rays are necessary during the first few weeks to detect any tendency toward loss of alignment. Open reductions were frequently necessary in this group.

CARPALS

Two hundred and thirty-seven carpal fractures were encountered. Navicular fractures require long immobilization, but in our experience fresh fractures have usually united if given sufficient time.

Next to the most frequent carpal fracture seen is the triquetrum. A minute fragment may be the only visible evidence of injury The wrist may be painful for three to six months. Transcarpal dislocation with fracture of the navicular must not be overlooked. If early closed reduction is possible the results are usually good.

METACARPALS AND PHALANGES

There were 4 263 fractures of the metacarpals and phalanges. We have been very much impressed with the seriousness of fractures of the metacarpals and phalanges in the relationship to tendon adhesions and resulting disability. Skeletal traction with either a pulp pin or fine Kirschner wire transfixing a phalanx has been utilized in almost all cases of oblique or spiral fractures of the metacarpals.

FEMUR

There were 24 fractures of the head and neck of the femur. Displaced neck fractures are nailed in the customary manner, particular care being taken to obtain a valgus position. Impacted ones have in most cases given excellent results with conservative treatment consisting of light traction.

Several of the twenty trochanteric fractures have been fixed with a Neufeld angle nail with a view to early mobilization. These have given very good results.

Shaft fractures (39) have been treated most successfully with skeletal traction of sufficient duration. This has not infrequently been combined with manipulation in traction. In the few cases where external pin fixation of the Roger Anderson type has been tried, results were unsatisfactory and we usually returned to traction or cast.

Supracondylar fractures also do well in traction. Angulation of the distal fragment may be very difficult to correct. This type of fracture has not infrequently resulted in limitation of extension of the knee.

PATELLA

Of the 138 patellar fractures, the majority showed displacement and many were severely comminuted Undisplaced fractures showed excellent recovery when early mobilization was carried out at the end of four to six weeks. Where the lower pole was badly comminuted, the

lower comminuted portion has been excised and the patellar tendon sutured to the proximal fragment with strong stainless steel wire. Even in these cases, early mobilization is the rule. Complete patellectomy is reserved for the extremely comminuted patella where prospect of restoring a smooth articular surface is poor. There have been three cases of post-traumatic osteochondritis of the patella following fracture by direct trauma.

TIBIA

Condylar fractures (102) have been mostly of the depressed type. Where the depression is not too marked, we have found excellent functional results following conservative treatment with early mobilization and late weight bearing. The occasional case has required surgical elevation of the depressed condyle with bone chips from the wing of the ilium to maintain position. The depression has usually been central; occasionally posterior.

There were 324 fractures of the tibia, many of them compounded. In general, we have found that oblique and comminuted fractures of the tibia and fibula are best treated in the following manner: A Kirschner wire is placed through the oscalcis and a traction bow applied. Under anesthesia the knee is brought to the edge of the table so that the leg hangs freely. Traction may then be applied by the surgeon with his foot by tying a sling through the traction bow, thus leaving the hands free to manipulate the leg. When alignment seems satisfactory, a short leg plaster is applied and allowed to set. The cast is then extended above the knee, using about thirty-five degrees of knee flexion to control rotation. The patient is placed in bed in traction with slings to support the cast. The cast may be wedged if necessary without disturbing traction. We believe the cast should be changed as infrequently as possible. Traction is maintained as long as necessary, usually six to eight weeks.

In spiral fractures of the tibia, early weight bearing and excellent position were afforded when open reduction was performed and the fracture fixed with a Mathewson sling of heavy stainless steel wire. Where the fibula remains intact, it is occasionally necessary to osteotomize it in order to secure good contact of the tibial fragments.

We have found multiple pin fixation methods undesirable in these fractures because of the reaction about the pinholes. Even where the process remains aseptic, the chronic low grade inflammatory reaction produced causes a lymphadema with fibrosis which results in limitation of function.

Fractures of the malleolus and epiphysis were 273 in number. Many of these were with minimal displacement and were easily cared for with good results. In displaced bimalleolar and trimalleolar fractures we have found an increasing tendency toward internal fixation of one or both malleoli in cases where closed manipulation has not given good anatomical reposition. This also allows earlier mobilization.

TARSALS

Fractures of the os calcis comprised the majority of the 273 fractures of the tarsal bones.

A wide variety of methods have been used in the treatment of os calcis fractures. The Böhler technique results in a good reduction if the fracture is not extensively comminuted, as does a multiple pin procedure. The latter allows freedom of ankle motion during healing of the fracture. Equivalent results are usually obtainable however, by simple compression to correct the widening deformity and casting. Triple arthrodeses have been done in approximately 10 per cent of the os calcis fractures.

METATARSALS AND PHALANGES

Metatarsal and phalangeal fractures numbered 3,704. Here, as in metacarpal and phalangeal fractures, skeletal traction may be necessary in oblique, spiral or comminuted fractures. Immediate weight bearing is the rule, either with a felt arch support or a walking cast.

In general, we have been impressed with the advantages of immediate treatment of all fractures, of complete and careful debridement of all compound fractures, and with the prophylactic use of systemic and local sulfonomides and especially the prophylactic use of penicillin. We have not hesitated to use wire or plating if necessary to maintain the proper position of fragments in compound fractures.

SUMMARY

The fractures experienced by approximately sixty thousand people over a period of two and one-half years totaled 13,261. These fractures are briefly classified and described.

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CARDIAC PATHOLOGY AS RELATED TO ANESTHESIA*

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DURING recent years, the importance of the preoperative examination of the prospective surgical patient has been recognized universally. The completeness of that examination will necessarily depend upon the urgency and seriousness of the operation, the availability of the patient before operation, and the general physical condition of the patient. During this preoperative examination, whether by surgeon, consulting internist, or anesthesiologist, the cardiovascular system is under close scrutiny.

Marvin[1] has pointed out that the "most helpful evidence we can obtain regarding the heart's functional condition is the record of its response to what might properly be termed the stress and strain of daily life:—the walking, the running, the stair climbing, the periods of emotional excitement, the innumerable mental and physical activities in which we daily indulge." If the history reveals breathlessness on exertion, orthopnea requiring the use of two to three pillows, cough and ankle edema, physical examination takes on an increased importance. Such an examination then should include a determination not only of blood pressure, pulse, and cardiac thrills, murmurs, rate and rhythm, but also of venous distension, cyanosis, location of apex beat, basal rales, pleural effusion, liver enlargement, ascites and ankle edema. In addition to the routine urinalysis and blood counts, special examinations may properly include sedimentation rate, circulation time, venous pressure, electrocardiograms, and fluoroscopy.

WHEN MILD CONGESTIVE FAILURE IS PRESENT

If such an examination shows the pressure of mild to moderate congestive failure, operation should be delayed, if possible, and adequate preoperative cardiac treatment instituted. If no previous digitalis has been administered,

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* Read before the Section on Anesthesiology, at the Seventy-fourth Annual Session of the California Medical Association, Los Angeles, May 6-7, 1945.
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